Low blood pressure, low mood?

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Abstract

***Objective*—To determine whether a set of physical symptoms is associated with low blood pressure and to investigate the possible role of psychological factors in their occurrence.**

***Design*—Analysis of data collected by questionnaire and physical screening from the first phase of the Whitehall II study, a cohort study of an employed population.**

***Setting*—23 civil service departments in London.**

***Subjects*—10 314 male and female London based civil servants aged between 35 and 55.**

***Main outcome measures*—Symptoms of dizziness-giddiness and unexplained tiredness; psychological functioning as measured by the 30 item general health questionnaire in which the response "no more than usual" to an item about disease was scored as indicating chronic illness.**

***Results*—Dizziness-giddiness in men and unexplained tiredness in both men and women were significantly related to low systolic blood pressure. There was a highly significant inverse relation between general health questionnaire score and systolic blood pressure for both men and women, which persisted after controlling for potentially confounding variables, including age, body mass index, drug treatment, physical illness, and exercise. This association of low blood pressure with physical symptoms was no longer significant when general health questionnaire score was controlled for.**

***Conclusions*—There seems a strong relation between low systolic blood pressure and minor psychological dysfunction. Associated physical symptoms seem to be secondary to the primary disturbance in mental state.**

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Introduction

Considerably more attention is given to the dangers of high rather than low blood pressure in published research, which is hardly surprising when high blood pressure is both life threatening and potentially treatable.

Recently, interest has emerged in the concept of a hypotensive syndrome consisting of somatic symptoms such as tiredness, dizziness, and headaches with, occasionally, some minor psychiatric symptoms such as anxiety and depression,[1] although these accounts are largely anecdotal. The hypotensive syndrome is diagnosed in continental Europe, and numerous treatments are used, ranging from harmless tonics to digoxin, amphetamine, and ergotamine.[1] The existence of such a syndrome has been subjected to little empirical scrutiny and been termed a "non-disease,"[2] although several studies have provided some support for its existence. One recent study found an association between low systolic blood pressure and both tiredness and feelings of faintness.[3] An earlier study reported that both low systolic and low diastolic blood pressures were related to tiredness, though only in women.[1] In a study of 1302 middle aged women in which age alone was controlled for and no account was taken of other potentially confounding variables Bengtsson *et al* found an increased prevalence of several symptoms in those with low systolic blood pressure (below 120 mm Hg), including general fatigue, overexertion, dizziness, and a readiness to cry.[4]

These rather non-specific symptoms suggest the possibility of a primary psychological disturbance. Although there have been studies of the relation between personality or mental state and hypertension,[5,6] little attention has been paid to a link between low blood pressure and psychological disturbance and the possible role of this link in the relation between low blood pressure and physical symptoms. To some extent this may be owing to the shortage of studies with sufficient demographic, medical, and psychiatric information on a large enough number of subjects to enable potential confounding variables to be identified and controlled for. This is the purpose of our report from the Whitehall II study.[7]

Subjects and methods

The Whitehall II study was set up to investigate social, occupational, and lifestyle influences on health.[7] A cohort of male and female civil servants based in London underwent medical screening under standardised conditions and completed a detailed questionnaire inquiring into a wide range of physical, psychological, social, and demographic factors. The response rate, after excluding those who were ineligible, was 73% (74% among men, 71% among women). Altogether 6829 men and 3351 women completed the general health questionnaire,[7a] making a total of 10 180. At the time of screening, 1985-8, the cohort was aged between 35 and 55.

Blood pressure measurement—Two blood pressure readings were taken with the Hawkesley random zero sphygmomanometer after the subject had rested quietly for five minutes, as recommended by the American Heart Association.[8] Conditions were standardised and the measurements taken by specially trained research nurses. The means of the two systolic and diastolic readings were calculated.

Psychological measures—The 30 item general health questionnaire was the main measure of psychiatric morbidity. It is widely used and has been validated for this study.[9] The questionnaire can be scored in two ways. The conventional method takes the response "no more than usual" to an item describing a disease process as an indicator of no illness. The method suggested by Goodchild and Duncan-Jones takes the same response as an indicator of chronic illness.[10] This modification in scoring predicts cases better than the conventional scoring method[10] and correlates more closely with other measures of neuroticism.[11] It also gives a measure of both acute and chronic morbidity and is more normally distributed, making it better suited for statistical analysis. We used the modification

of Goodchild and Duncan-Jones in this study, with the recommended cut off point for a case being 13 or more out of a possible 30 points.

Statistical methods—Men and women were mostly analysed separately, but when sex was controlled for it was entered as an independent variable in a linear regression model. Analyses were conducted by linear regression when the dependent variable was continuous. Logistic regression was used when the dependent variable was dichotomous (SAS computer software V6·03; SAS, Carey, United States). Confounders were controlled for by entering them as independent variables in the above models. Blood pressure was analysed mostly in quartiles rounded off to the nearest mm Hg.

Results

There were substantial differences between men and women in blood pressure, physical symptom score, and general health questionnaire score. Systolic blood pressure was divided into quartiles separately for men and women. Table I shows the numbers in each quartile and the odds ratios per quartile for the symptoms dizziness-giddiness and unexplained tiredness together with the mean questionnaire scores when age alone was controlled for. Apart from dizziness-giddiness in women, the other symptoms and scores showed increasing illness with decreasing systolic blood pressure. Systolic blood pressure and symptom score both increased with age, while the questionnaire score decreased. Male sex was associated with higher blood pressure and lower symptom and questionnaire scores.

TABLE I—*Prevalence of symptoms of dizziness-giddiness and unexplained tiredness (as odds ratios*) and mean general health questionnaire scores† for each quartile of systolic blood pressure (age controlled for)*

Systolic pressure (mm Hg)	No of subjects	Dizziness-giddiness	Unexplained tiredness	Questionnaire score (mean)
		Men		
≤115	1847	1·50	1·20	9·6
116-123	1603	1·51	1·16	9·3
124-133	1743	1·34	1·03	9·2
≥134	1636	1·00	1·00	8·9
		Women		
≤109	884	1·10	1·33	10·9
110-118	797	0·84	1·01	10·1
119-130	884	0·96	1·03	9·8
≥131	786	1·00	1·00	9·6

*Compared with highest quartile of blood pressure.
†Scoring method of Goodchild and Duncan-Jones[10]; higher score implies higher neuroticism.

The many potential confounding factors other than age were considered in turn. Table II shows their effects on blood pressure, symptoms, and questionnaire score when age and sex were controlled for. For ease of presentation the two symptoms are combined into a single variable. Being married compared with being single was associated with lower blood pressure and symptom and questionnaire scores. Body mass index (weight/(height^2)) was divided into quartiles. Increasing body mass index was associated with increasing blood pressure and symptom scores and decreasing questionnaire score . White subjects had the lowest symptom scores, with blood pressure and questionnaire scores intermediate between scores for Afro-Caribbeans and subjects from the Indian subcontinent. Grade level, which is a sensitive measure of social class, was associated with a small but significant increase in blood pressure in the lower grades. There was a very pronounced increase in symptom score and no change in questionnaire score in the lower grades. Frequency of alcohol consumption over the previous 12 months was not significantly related to symptom score. It was, however, positively associated with blood pressure and questionnaire score. Smoking was not significantly related to symptom score or blood pressure. Smokers had slightly higher questionnaire scores. The presence of a longstanding physical illness was not significantly related to blood pressure, though it was strongly associated with increased symptom and questionnaire scores. Physical exercise was included as a binary variable. The low exercise group consisted of those who took less than one hour of vigorous exercise a month. Low exercisers had no difference in blood pressure, but they did have lower symptom scores and higher questionnaire scores. Those who had been told in the past that their blood pressure was raised were found, as expected, to have higher blood pressures than those who had not. In addition, they also had raised symptom and questionnaire scores. Blood pressure increased the later in the day it was taken, though symptom and questionnaire scores were not related to the time of day of the examination.

The use of drug treatments was recorded at the time of the screening examination. Table III shows that symptom and questionnaire scores were higher when any drug was taken but that blood pressure was no different. Most types of drugs taken by the subjects, such as laxatives, mild analgesics, or antacids, do not affect blood pressure. As expected, the use of antihypertensive drugs was strongly associated with blood pressure and the use of antidepressants with questionnaire score. Both were strongly related to symptom score. As subjects taking antihypertensive agents had higher symptom scores, this could not account for the inverse association between symptom scores and blood pressure. Subjects taking these drugs were excluded from subsequent analyses. When all subjects taking any kind of drug were excluded, the effect of blood pressure on symptom and questionnaire scores did not differ significantly.

Various aspects of diet that could plausibly be linked to both blood pressure and physical or psychological factors were investigated. These were frequency of eating meat, fish, fresh fruit and vegetables, and daily tea and coffee consumption. Plasma cholesterol concentration was also examined because it gives an estimate of total fat intake, especially of saturated fat. None of these, when adjusted for age and sex, were significantly related to blood pressure or questionnaire or symptom score and so they were unlikely to have been confounders.

PHYSICAL SYMPTOMS AND SYSTOLIC BLOOD PRESSURE

A logistic regression model was constructed including all the above confounders so that the independent relation between physical symptoms and systolic blood pressure could be examined. Age and body mass index were entered as continuous variables, while all the others were entered as discrete variables with the values shown in table II. Systolic blood pressure was entered in quartiles. Men and women were analysed separately. The symptoms of tiredness for no apparent reason and dizziness-giddiness were entered in turn as the dependent variable. Three of the four associations (table IV) were significant.

QUESTIONNAIRE SCORE AND BLOOD PRESSURE

A large difference in questionnaire scores was found between those reporting and not reporting the symptoms dizziness-giddiness and unexplained tiredness (mean score in subjects reporting dizziness-giddiness 13·0% and in those not reporting it 9·1, $p<0·0001$; mean score in those reporting unexplained tiredness 13·3 and in those not reporting it 8·5, $p<0·0001$). When questionnaire score was controlled for in the logistic regression model the association between systolic blood pressure and the two physical

symptoms was reduced by about a third and was no longer significant (table IV).

To investigate the relation between systolic blood pressure and psychological state further a linear regression model was constructed including all the above potential confounders. Age, body mass index, and questionnaire score were entered as continuous variables, with the score as the dependent variable and the rest entered as discrete variables. Men and women were again analysed separately. Systolic blood pressure (entered in quartiles) was found to be highly negatively related to questionnaire score in both men ($p<0.0001$) and women ($p<0.0001$). Table V shows the adjusted (least squares) mean scores for men and women for each quartile of systolic and diastolic blood pressure, with associated F values. The increase in each of these scores with decreasing systolic blood pressure was almost linear in men, but they differed little between the highest and second highest quartiles of blood pressure in women. Diastolic blood pressure shows a similar, though weaker, trend in men and has little relation with questionnaire score in women.

We analysed the questionnaire as a continuous variable. Validation against a psychiatrist's diagnosis suggested that a score of 13 or above is an indicator for a diagnosis of neuroticism. We used this definition of a case as the dependent variable in a logistic regression with maximum likelihood analysis and all the other variables entered as discrete variables with the same values as in tables II and III. There was a highly significant relation between a case defined by the questionnaire score and systolic blood pressure (entered in quartiles). This relation was present for men (odds ratio per quartile 1·13, 95% confidence interval 1·06 to 1·20; $p<0.0001$) and women (1·20, 1·10 to 1·31; $p<0.0001$). This implies a 43% higher prevalence of neuroticism in the lowest compared with the highest blood pressure quartile in men and a 72% higher prevalence in women.

The same method was then used to look at each of the 30 items of the general health questionnaire individually as the dependent variable in a logistic regression model (again using the scoring method of Goodchild and Duncan-Jones[10]), with all the previously mentioned confounders controlled for. All relations were in the direction of greater morbidity with lower blood pressure. A wide spread of symptoms was found—for example, feeling scared and panicky, poor concentration, feeling under strain, unable to enjoy normal activities—all of which were highly related to systolic blood pressure ($p<0.001$). None of the indicators of severe psychiatric morbidity—for example, feeling that life was not worth living—was reported significantly more often.

TABLE II—*Systolic blood pressure, combined symptom scores of unexplained tiredness and dizziness-giddiness (as odds ratios†), and mean general health questionnaire scores‡ for confounding variables (age and sex controlled for)*

Confounder	No (%) of subjects	Systolic pressure (mm Hg)	Score: Symptoms	Score: Questionnaire
Marital state:				
Married or cohabiting	7614 (74·1)	121·9	1·00	9·3
Single	1690 (16·4)	124·9 ***	1·23	10·3 ***
Divorced	833 (8·1)	121·8	1·09	11·0
Widowed	139 (1·4)	122·7	0·91	10·7
Body mass index (quartile):				
First	2575 (25·0)	119·4	1·00	10·1
Second	2575 (25·0)	122·0 ***	1·08	9·7 **
Third	2575 (25·0)	124·2	1·12	9·5
Fourth	2575 (25·0)	126·8	1·26	9·5
Ethnic group:				
Indian subcontinent	577 (5·6)	120·8	1·00	10·2
White	8979 (87·2)	122·4 ***	0·70 **	9·7 ***
Afro-Caribbean	360 (3·5)	126·8	0·83	8·1
Job grade:				
1 (highest)	1148 (11·1)	120·7	1·00	9·7
2	1891 (18·3)	122·0	1·32	9·9
3	1426 (13·8)	121·6 ***	1·49	9·9
4	1976 (19·2)	122·3	1·57 ***	9·9
5	1541 (14·9)	122·8	1·71	9·8
6	2332 (22·6)	122·8	1·75	9·3
Alcohol consumption:				
Twice a day	352 (3·4)	125·2	1·00	10·7
Daily	2650 (25·8)	123·4	0·96	10·1
>Once a week	4093 (39·8)	121·5 *	0·87	9·6 ***
>Once a month	1280 (12·4)	121·7	0·97	9·6
Special occasions	1472 (14·3)	122·2	1·06	9·5
Never	437 (4·2)	122·7	1·17	9·1
Smoking:				
Smoker	1883 (18·3)	122·0	1·00	10·0 *
Non-smoker	8417 (81·7)	122·3	0·94	9·6
Physical illness:				
Yes	2242 (29·3)	121·9	1·00 ***	10·5 ***
No	5401 (70·7)	121·8	0·61	9·3
Ever told BP up?				
Yes	1566 (15·6)	130·6 ***	1·00 ***	10·3 ***
No	8468 (84·4)	120·5	0·67	9·6
Vigorous exercise:				
Low	5700 (57·2)	122·2	1·00 ***	10·0 ***
High	4269 (1	122·3	1·53	9·3

†Compared with first category of each variable.
‡Scoring method of Goodchild and Duncan-Jones.[10]
*p<0·01; **p<0·001; ***p<0·0001.
BP = blood pressure.

TABLE III—*Mean systolic blood pressure, combined symptom scores (as odds ratio†), and mean general health questionnaire scores‡ (sex and age controlled) according to reported use of drugs at time of examination*

Drug treatment	No (%) of subjects	Systolic pressure (mm Hg)	Score: Symptoms	Score: Questionnaire
Any drug:				
Taking	2521 (24·7)	122·1	1·00 ***	11·0 ***
Not taking	7679 (75·3)	122·3	0·56	9·2
Antihypertensives:				
Taking	335 (3·2)	130·9 ***	1·00 ***	10·4
Not taking	9973 (96·7)	122·0	0·53	9·7
Antidepressants:				
Taking	150 (1·5)	120·4	1·00 ***	16·1 ***
Not taking	10 010 (98·5)	122·3	0·36	9·6

†Compared with those taking drug treatment.
‡Scoring method of Goodchild and Duncan-Jones.[10]
***p<0·0001.

TABLE IV—*Relation between systolic blood pressure and physical symptoms before and after controlling for general health questionnaire score† (all confounders controlled for). Values are odds ratios‡ (95% confidence intervals)*

Symptom	Before	After
Men		
Dizziness-giddiness	1·56 (1·11 to 2·21)*	1·42 (1·00 to 2·02) NS
Feeling tired for no reason	1·38 (1·11 to 1·72)***	1·26 (0·99 to 1·60) NS
Women		
Dizziness-giddiness	1·26 (0·87 to 1·82) NS	1·14 (0·78 to 1·66) NS
Feeling tired for no reason	1·49 (1·10 to 1·97)**	1·29 (0·96 to 1·74) NS

†Scoring method of Goodchild and Duncan-Jones.[10]
‡Difference between lowest and highest quartiles of systolic blood pressure.
*p<0·05; **p<0·01; ***p<0·005.

TABLE V—*Mean general health questionnaire score† for each quartile of systolic and diastolic blood pressure (all confounders controlled for)*

	Men	F value	Women	F value
	Systolic blood pressure			
Quartile:				
1 (Lowest)	9·6		11·0	
2	9·1	17·5***	10·4	16·8***
3	9·0		9·6	
4	8·5		9·5	
	Diastolic blood pressure			
Quartile:				
1 (Lowest)	9·3		10·3	
2	9·2	5·4*	10·4	2·4
3	9·0		10·1	
4	8·7		9·7	

*p<0·05; ***p<0·0001.
†Scoring method of Goodchild and Duncan-Jones.[10]

Discussion

These findings support the existence of a hypotensive syndrome. Dizziness-giddiness and unexplained tiredness were reported more often by those with low systolic blood pressure, which agrees with previous results.[1,3,4] The strong association between questionnaire score and systolic blood pressure is consistent with the psychiatric component of the hypotensive syndrome as used on the continent. Indeed, these physical symptoms are partly, although not entirely, accounted for by the questionnaire score. Of course,

experiencing dizziness-giddiness and unexplained tiredness probably has some psychological sequelae, but the relative strength of the association of blood pressure with questionnaire score—and the fact that the association is not weakened when symptom score is controlled for—suggests that the syndrome may consist primarily of psychological dysfunction. The association with low blood pressure of a wide spread of individual items in the general health questionnaire, including feeling low, panicky, unable to concentrate, is typical of minor psychiatric morbidity (generalised neurosis) and there is no evidence of a particular specific condition—for example, depression, anxiety state.

These results are consistent with the finding of Bengtsson *et al* that a readiness to cry was reported more often by those with low systolic blood pressure.[4] It is also worth pointing out that in a study of the psychiatric aspects of hypertension the only significant relation between psychiatric symptoms and blood pressure was a "negative" one: women with low rather than high blood pressure reported trouble getting to sleep.[12]

The association between hypotension and psychological dysfunction contrasts with the traditional view that hypertension may be aetiologically linked with personality or certain mental state abnormalities. Thus Cochrane argues that repressed hostility and aggression are features of the "hypertensive personality,"[13] and others claim that people with a type A personality, characterised by competitiveness, time urgency, etc, show greater increases in blood pressure with stress than people with a type B personality. Several studies have found a link between psychiatric symptoms and hypertension. Rabkin *et al* found a threefold increase in major depression in patients undergoing treatment for hypertension,[6] and Nakagawara *et al* found an increased frequency of hypertension in patients with endogenous but not non-endogenous depression.[14] Other studies, however, have failed to show such a link and attribute any apparent connection between hypertension and psychiatric symptoms either to antihypertensive treatment[12] or to the consequences of being diagnosed, or labelled, hypertensive.[15]

It is interesting that the association found here was only weakly significant for diastolic blood pressure. Bengtsson *et al*, who found an increased frequency of several symptoms in subjects with low systolic blood pressure, do not comment on whether the relation was still present with diastolic blood pressure,[4] while Wessely *et al* mention that feelings of faintness and tiredness were associated with both low systolic and low diastolic blood pressures.[3]

Given the novelty of these results, especially the apparent strength of the relation of blood pressure to mental state, it is worth emphasising the rigorousness with which potentially confounding variables were controlled for. Because antihypertensive and antidepressant treatments were profoundly related to blood pressure and mental state respectively, those taking these drugs were taken out of the multivariate analysis. Subjects who score as cases with the modified general health questionnaire[10] might be more likely to be hypochondriacal or anxious about their health and to visit their general practitioner; if they also happen to be hypertensive, hypertension is more likely to be detected and treated than it would be in less anxious hypertensive subjects who do not visit their general practitioner. This could confound the results either if those taking antihypertensive drugs are dropped from the analysis, as they were here, or if they are included, by lowering the blood pressure of subjects receiving treatment. However, 34·5% of those taking antihypertensive treatment were cases by the scoring method of Goodchild and Duncan-Jones of the general health questionnaire.[10] This proportion is similar to the proportion of cases in the rest of the sample (31%). Therefore subjects who are cases by the method of scoring of Goodchild and Duncan-Jones[10] are not more likely to have had their blood pressure checked by self referral to their general practitioner. This non-significant difference is even smaller than expected, given the possible psychological side effects of treatment and of labelling as hypertensive.

Labelling anticipates another possible weakness in this study—that is, that no attempt was made to control for the effect that a diagnosis of hypotension in the past might have had on current mental state. If this study had been conducted in Germany, for instance, this may have been relevant, but the fact that such an entity is more or less unrecognised in the English speaking world makes it unlikely that any of these subjects will ever have received such a label. Indeed, the association of low blood pressure with decreased cardiovascular morbidity would be more likely to have had a reassuring rather than a stigmatising effect.

Although it is tempting to speculate on possible mechanisms—for example, cerebral hypoperfusion or different degrees of monoaminergic activity—the link between low to normal blood pressure and minor psychiatric morbidity, as with the possibility of a direct causal relation, cannot at this stage be commented on.

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